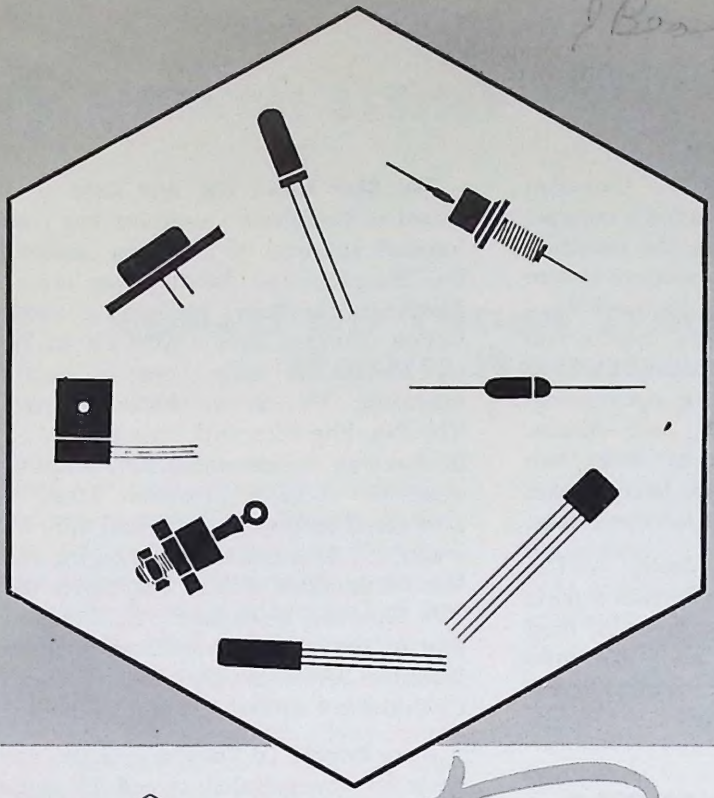


MARCH
1960
EDITOR: AL JONES

ROGERS Booster

CONTENTS

Industry News 2
Speed Up Those Transistor Radio Repairs 3
Germanium Diode in Radio and TV 5
Tube Popularity List 7

A MAGAZINE DEVOTED TO THE INTERESTS OF RADIO—TV TECHNICIANS IN CANADA

INDUSTRY NEWS

Microwave for the Far North — Canadian National Railways have awarded a contract to a Canadian company for the construction of a 1200-mile-long microwave system from Grande Prairie, Alta., to the Yukon-Alaska border. The system, which will be linked with communications systems in Alaska, will greatly improve communications in western Canada and Alaska. Scheduled for completion in about two years, the contract should provide one million man-hours of work for Canadians.

TV Advertising Proves Costly — The Royal Commission on Price Spreads reports that the total advertising cost in food marketing between 1949 and 1957 rose 397%. The emergence of television in the 1950's played a major part in this increase they say.

The BBG Blows Hot and Cold — The Board of Broadcast Governors has recommended approval of television service for the Dauphin and Swan River areas of Northern Manitoba through a satellite station operated from CKOS-TV in Yorkton, Sask. No early hope is seen for extending TV service further north to The Pas, Flin Flon and Thompson. . . . A license was recommended for operation of a satellite at Baldy Mountain, Man., with a power of 9500 watts video and 4750 watts audio. . . . Licenses were denied for operation of satellites at The Pas, Swan River, Flin Flon and Moon lake. . . . Denials are due to the cost of providing microwave facilities. Service is only provided when the cost does not exceed $15 per TV home.

More Private TV Coming — Seven applicants for new privately-owned TV stations in Montreal have been announced by the Department of Transport. Three wish to operate English-language stations and four prefer French.

❖ ❖ ❖

Front Cover

Semiconductors come in many shapes and sizes. A representative assortment are shown in shadow form in our front cover hexagon frame.

Back Cover

This reproduction of one of our trade ads lists the wide range of Rogers Semiconductors designed to meet present day equipment requirements.

Free interchangability lists for both transistors and diodes are available from Rogers. Address all requests c/o the Booster.

Speed Up Those Transistor Radio Repairs

Small sets have always been a problem to the service technician. Because of their small size, a defect may take longer to locate and repair than in a larger set although the customer seldom realizes this. It is so very small and (in some cases) costs so little — how can such a service charge be warranted? Now a good transistor portable is not exactly cheap, but it is even smaller and falls into the same category in the owner's mind.

Quite aside from the service charge, there is another good reason for speeding up diagnosis. The pocket-size set is carried like a watch and the owner feels lost without it. You will make him very happy if you can get it back in his pocket quickly.

General Rules — First of all, the specialist in this field will require a good voltmeter and a 20,000-ohms-per-volt type will be found satisfactory in most cases. Secondly, he will require a set of miniature tools including a small soldering iron. Thirdly, he will require a systematic method.

We will assume that the reader knows there are two basic types of transistors commonly used in portables — the n-p-n and the p-n-p. The n-p-n is more nearly like a vacuum tube in that one element emits electrons that are influenced by the base as they are attracted to the collector which has a positive potential.

In the p-n-p one difference to be noted is the direction of electron flow, this being from the collector to emitter. The externally applied voltages are also reversed, the most positive potential being applied to the emitter.

As applied in transistor portables, these transistors may be further divided into three groups: (1) Low-power types as used in r-f, local oscillator, converter, i-f stages and audio amplifiers with less than 50 milliwatts output. (2) Medium-power types may be found in first audio stages or in audio output stages of small portables. (3) High-power types as used in audio output stages of car receivers or in the larger portables.

Troubleshooting — Naturally, the first thing to check is the battery voltage. This measurement should be made under load and the reading should be within 10% of rated voltage if ordinary zinc-carbon cells are used or within 5% in the case of mercury batteries. This check should be made regardless of the symptoms because run-down batteries can cause the set to be weak or dead, the sound to be distorted and sometimes lead to instability and oscillation.

At this point it will be most helpful if the manufacturer's specifications on current drain are available because it is easily measured while checking the battery. A piece of paper or any insulating material is slipped between the battery terminal and its clip; then a milliammeter, set to the appropriate range, is connected be-

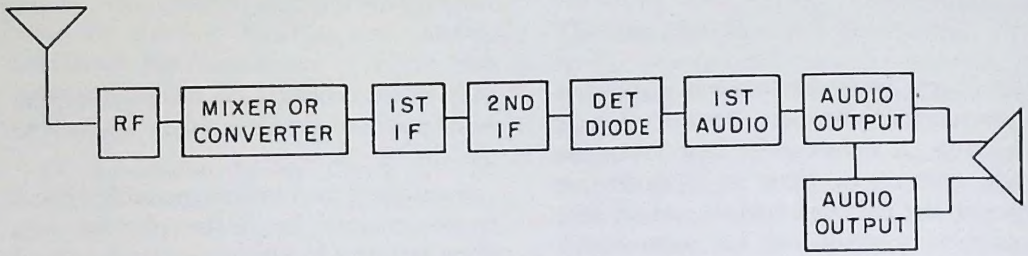
tween the two. The receiver should be set for no signal and minimum volume. If the current drain is about 25% above normal, a short rather than an open circuit should be looked for. But, if the drain is several times normal, this narrows it down to a short in the "A" line and quite possibly in an electrolytic capacitor.

Now, assuming that the battery voltage and drain are normal, it is possible that the electrolytics are a bit low on capacitance. So, if there are symptoms of instability (oscillation, motorboating etc.) try good electrolytics across those already in the circuit. It could be that you will hit the jackpot here — an easy repair, a reasonable service charge and a happy customer. If not, let's carry on and tie the fault down to a particular stage.

Stage Isolation — There are two methods by which the fault may be narrowed down to one stage — the "click" method and the signal generator. The use of the latter is often useful in the case of a receiver that is only weak but the click method is fastest for a completely dead set. For this test a 10,000-ohm resistor is connected in series with a test lead having clips at both ends. (From what you have already read about transistors, you know that the resistor will prevent damage to them as well as to i-f transformers.)

Consider Figure 1 which is a block diagram of a very good transistor portable. One clip is connected to ground and the other touched to transistor elements. A click should be heard at the base of the first audio transistor unless the fault is in one of the audio stages. If a click is heard, move to the front end. A click should be heard at the collector of the mixer and, if not, the trouble is in one of the i-f stages.

Whether clicks are heard in the i-f stages depends upon how high their gain is. Sometimes the gain is insufficient. If there are two stages, a click may be obtained at the first i-f collector or base but, with only one stage, the collector of the mixer may be the first click point after the first audio.



If so, move to the r-f stage. A click should be heard at the base as well as at the hot end of the loop antenna when touched by a metallic object held in the hand. Transistor portables vary considerably in their response to these tests and a little preliminary experimentation will be helpful in evaluating results in future jobs.

Pinpointing the Fault — Once the defective stage or section has been isolated, the next step is to locate the exact position of the fault. Now is the time to bring out the voltmeter but be sure to measure the source of the voltage supply first because, if this is not correct, allowances will have to be made in all other measurements. If the source is normal, stage voltages are usually accurate within 10% for voltages above one, or within 1/10 volt for lower values.

In order to obtain a high rectification efficiency the diode shunt capacitance Cd must be small compared to the load capacitance C. The germanium diode shunt capacitance is about 1 uuf thus allowing a high efficiency.

(Cont'd on page 6)

Germanium Diodes in Radio and TV

The tremendous growth in transistor developments since its discovery in 1948 tends to overshadow the fact that germanium semi-conductors have been used in radio and TV sets for a number of years. The use of the germanium diode is now firmly established in electronic equipment and over recent years numerous improvements have been made to their performance and characteristics.

The basic material for manufacturing germanium diodes is highly purified germanium dioxide. The oxide is reduced to metallic germanium. Small quantities of impurities are added during the melting process and by controlling the type and quantity of these impurities different resistivity materials are produced thus providing diodes with differing characteristics.

The treated germanium is cut into pieces about 1 m.m. square and mounted on a carrier. A contact wire, the "whisker", is fitted with its point pressing on the surface and the assembly is placed in a small glass cylinder. The leads are fused into either end and the unit is hermetically sealed. It is of the utmost importance to obtain a perfect seal from the atmosphere as the germanium is easily "contaminated" and its performance impaired — particularly from the effects of water vapour.

The germanium diode characteristic is very similar to the older vacuum diode as can be seen from Fig. 1.

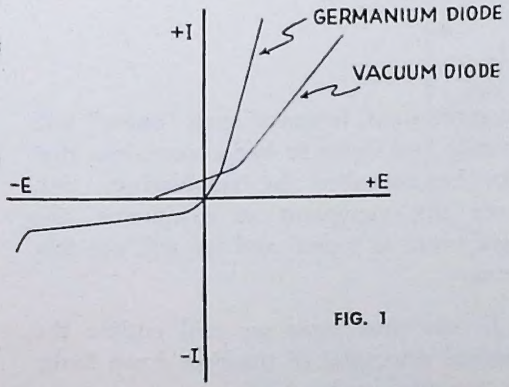


FIG. 1

Notice three important electrical differences.

(I) The forward resistance of the germanium diode is very low. That is to say at a given forward current the voltage drop across the diode is low. There are of course limits to the forward current in the germanium diode. The maximum allowable forward current in a IN87 video detector for example is 50MA. The forward voltage drop is 0.2 volts at 0.1MA forward current.

(II) The germanium diode curve passes through the zero point on the graph i.e. there is no current flow in the diode at zero signal voltage. This is important in A.G.C. and measuring circuits.

(III) Whereas the vacuum diode passes no current in the reverse direction, an appreciable current may flow through the germanium diode particularly at high inverse voltages. In the germanium diode also, this reverse current increases with temperature. Hence the use of silicon diodes, with their lower reverse current, for high temperature applications. Silicon diodes are not seen much in radio and TV because they are still relatively expensive. They could be used however as a replacement for germanium in a high ambient temperature location if required.

The most common applications for germanium diodes are as signal detectors on T.V., AM and FM radio, and as AGC rectifiers in radio receivers.

Fig. 2 shows a typical video detector circuit using a germanium diode, the advantages being the absence of hum, the small dimensions which allow easy screening and the high efficiency.

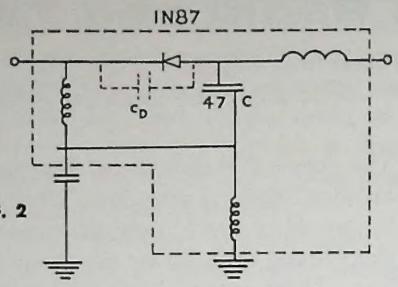


FIG. 2

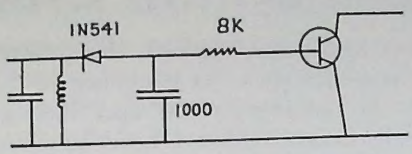


FIG. 3

The use of germanium diodes in transistorized receivers is obviously essential but does require care in design of detector stages because the transistors require *power* drive from the detector whereas with tubes the drive requirement is primarily voltage. It is also necessary to allow for the spread in base current of the first audio transistor. This is usually accomplished by the use of a resistor in series with the base connection. A typical current is shown in Fig. 3.

The replacement of germanium diodes is relatively infrequent compared to vacuum tubes but is sometimes necessary. There are hundreds of diodes available under many different numbers and here it is useful to mention two diodes types IN87 and IN478 which between them will replace about a hundred different diode types in radio and TV detector applications.

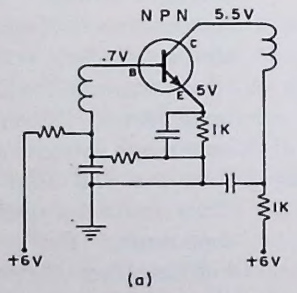
In both cases these diodes have an equal or better forward and reverse characteristic than the types they replace. A complete list of replacement types is available by writing to the "Booster".

Semiconductors come in many shapes and sizes. A representative assortment are shown in shadow form in our front cover hexagon frame.

This reproduction of one of our trade ads lists the wide range of Rogers Semiconductors designed to meet present day equipment requirements.

Speed Up Those Transistor Radio Repairs (Cont'd)

FIG. 2



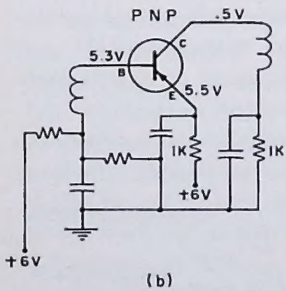


Figure 2(a) shows a typical n-p-n amplifier stage and (b) is the same stage using a p-n-p transistor. The typical voltages shown are with respect to ground.

In the discussion of typical faults and their symptoms which is to follow, it will be necessary to refer to transformers and resistors as being "open". Now, in a car receiver where the emitter resistor also serves as a fuse, such an "open" can occur. In most cases however such "opens" will usually boil down to bad connections that can be remedied by resoldering. But, from the viewpoint of symptoms, the component is "open" and we will use that term.

In our next issue we will outline the general principles of tracking down faults in transistor stages.

TUBE POPULARITY LIST

Here's a Handy Reference List for stock checking purposes

The 25 most popular tubes

0Z4	6AQ5	6BZ7	12AU7A
1G3GT/1B3GT	6AU6	6CB6	12BA6
1X2B	6AX4GT	6CG7	12BE6
5U4GB	6BA6	6J6	12BY7A
5U8	6BQ6GTB	6SN7GTB	35W4
6AL5	6BQ7A	6U8/A	5OC5
		6W6GT	

These tubes constitute 41.1% of total sales.

Next 50 most popular tubes

1R5	6AM8	6CD6GA	6X8	12SK7
1S2A	6AN8	6CS6	7AU7	12SN7GT
3AU6	6AT6	6CU6	12AT6	12SQ7
3CB6	6AV6	6DQ6A	12AT7	12W6GT
3V4	6AW8A	6S4A	12AV6	25BQ6GTB/ 25CU6
4BQ7A	6BC5	6SA7	12AX4GTA	25CD6GB
4BZ7	6BE6	6SK7	12AX7	25L6GT
5AS4	6BQ5	6SQ7	12BH7A	35L6GT
5CL8	6BZ6	6T8	12DQ6A	35Z5GT
5Y3GT	6C4	6V6GT	12SA7	50L6GT

These tubes constitute 28.9% of total sales.

ROGERS

REFERENCE BULLETIN NO. 2

Semiconductors. As the list below indicates, Rogers now offers a wide, versatile range of simiconductors to meet your new-equipment requirements. Because this extensive line of semiconductors is produced in quantity by modern production methods; they have good availability and are low in price. For stable characteristics and consistent dependability, you can always rely on Rogers. Condensed data is listed below. Complete technical information, availability and prices will be supplied upon request.

TRANSISTORS

Germanium Audio Frequency

OC70	General purpose BETA = 30
OC71	Medium gain BETA = 41
OC72	Low power audio output
2-OC72	Matched pair of OC72
OC73	Close tolerance medium gain
OC74	Medium power audio output
OC75	High gain BETA = 90
OC76	Low power switching
OC77	High voltage switching
OC80	High current switching

Germanium Audio Frequency Power

2N1314	37 watts dissipation BETA = 45
2N1315	37 watts dissipation BETA = 85
OC28	37 watts dissipation High Ic, High Vc
OC29	37 watts dissipation High Ic, High Vc
OC30	4 watts dissipation
2-OC30	matched pair OC30
OC35	37 watts dissipation High Ic
OC36	37 watts dissipation High Ic

Germanium High Frequency Power

OC22, OC23, OC24	10 watt dissipation at 2.5 Mc/s.

Germanium Phototransistor

OCP71	General purpose phototransistor

Silicon Junction

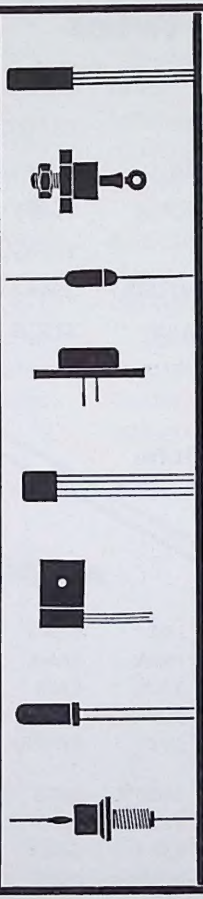
OC200	General purpose—P-N-P
OC201	General purpose BETA = 30 P-N-P
OC203	High voltage, medium gain. P-N-P

Germanium Radio Frequency

OC44	Converter for broadcast receivers f_{co} 15.0 Mc/s.
OC45	I.F. amplifier for broadcast receivers f_{co} 6.0 Mc/s.
OC46	High speed switching transistor f_{co} 3.0 Mc/s.
OC47	High speed switching transistor f_{co} 4.5 Mc/s.
OC139	Symmetrical N-P-N switching transistor
OC140	Symmetrical N-P-N switching transistor
OC141	Symmetrical N-P-N switching transistor
OC169	High frequency alloy diffused transistor
OC170	High frequency alloy diffused transistor
OC171	High frequency alloy diffused transistor

Germanium Subminiature

OC57	General purpose subminiature
OC58	General purpose subminiature
OC59	General purpose subminiature
OC60	General purpose subminiature output amplifier



DIODES AND RECTIFIERS

Germanium Junction Rectifier

OA31	Medium current power diode I = 3.5A

Silicon Junction Rectifiers

OA210	I max. 0.5 A P.I.V. 400
OA211	I max. 0.4 A P.I.V. 800
OA214	I max. 0.5 A P.I.V. 700

Silicon Zener Diodes

OAZ200 to OAZ207	Voltage range 4.7—9.1 V ±5%
OAZ208 to OAZ213	Voltage range 4.2—12.2 V ±15%

Silicon Junction Diodes

OA200	P.I.V. 50 V. I max. 50 mA
OA202	P.I.V. 100 V. I max. 30 mA

Germanium Junction Diode

OA10	Low hole storage computer diode

Germanium Gold Bonded Diodes

OA5	P.I.V. 100 V. General purpose switching.
OA7	P.I.V. 25 V. High speed switching.
OA47	P.I.V. 25 V. High speed switching.
1N281	P.I.V. 75 V. High conductance diode.
1N760	P.I.V. 60 V. Extremely fast recovery diode.
1N788	P.I.V. 60 V. Extremely fast recovery diode.

Germanium Point-Contact Diodes

OA70/1N87	Video detector.
OA72	High frequency diode.
OA73/1N616	Industrial diode.
OA79/1N541	a.m. and f.m. detector.
2-OA79/1N542	Matched pair OA79/1N541.
OA81/1N476	High voltage general purpose.
OA81C/1N477	Clip-in version of OA81/1N476.
OA85/1N478	High voltage general purpose.
OA85C/1N479	Clip-in version of OA85/1N478.
OA86/1N480	Low hole storage computer diode.
OA86C/1N119	Clip-in version of OA86/1N480.
OA90/1N87A	Subminiature video detector.
OA91/1N617	Subminiature OA81/1N476.
OA95/1N618	Subminiature OA85/1N478.
1N126	Subminiature JAN diode.
1N198	Subminiature JAN diode.

ROGERS

electronic tubes & components

A DIVISION OF PHILIPS ELECTRONICS INDUSTRIES LTD.
116 VANDERHOOF AVENUE, TORONTO, ONTARIO / BRANCHES: HALIFAX, MONTREAL, WINNIPEG, VANCOUVER

* Rogers Electronic Tubes are sold through Canada's Independent Electronic Parts Distributors